KNOWLEDGE

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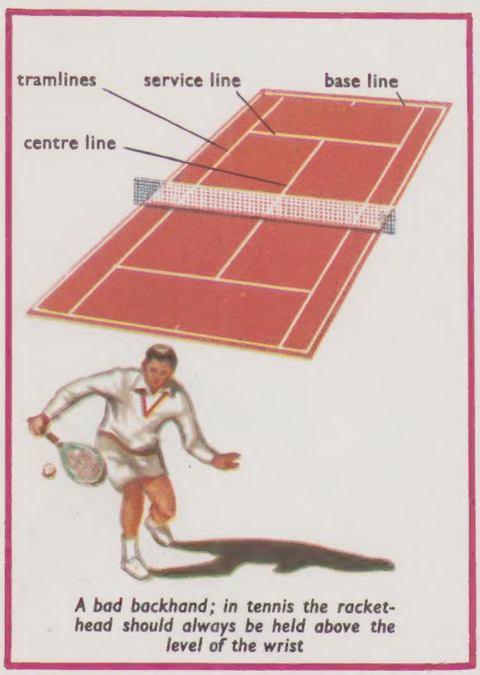
SPORT (part two)

IN our first article on sport we dealt mainly with team sports. We will now look at some of the individual sports, a large number of which can be placed under the heading Athletics. In these people show their ability to run, jump, and throw missiles.

Track events

The various forms of running are known as track events. These include sprinting, which is running at full speed on the flat, usually over distances of 100 and 220 yards; middle-distance running over distances of 440 yards, 880 yards, and 1 mile; long-distance running over distances of more than 1 mile; the 2 miles steeplechase, which includes four hurdles and a water jump in each of its eight laps; and hurdling, over hurdles between 2 feet 6 inches and 3 feet 6 inches high and over distances between 120 and 440 yards. In most international meetings the distances are slightly different, as they are adjusted to the metric system.

A very popular sort of track race is the relay race; in this a number of competitors combine to cover a certain distance, handing over a baton to each other at take-over points. Walking is another track event with a wide appeal.



A bad backhand; in tennis the racket-head should always be held above the level of the wrist

Badminton – a girl playing a backhand

Field events

Field events include all kinds of jumping and throwing; the four kinds of jumping are the high jump, long jump, pole vault, and 'hop, step and jump'. Weight throwing includes 'putting' the shot, in which a ball of solid metal is pushed from the shoulder; hammer throwing, in which a similar weight with a grip attached is thrown; throwing the discus, a circular slab of wood edged with metal; and throwing a javelin over 8 feet 6 inches in length, which is made of light metal or wood.

The Highland Games

The internationally famous Highland Games of Scotland provide a colourful and exciting feature in the world of sport. Among the most well-known Highland Games are those held annually at Inverness, Braemar, Oban, and Cowal. They are believed to have had their origin in the 1820's. The traditional programme began to take shape in the mid 1850's, and today includes athletics (with such events as putting the stone and throwing the hammer, as well as races and leaps), cycling, wrestling, and local mountain races.

An event of particular interest in the Highland Games is that of Caber Tossing. The earliest mention of this traditional Scottish contest was in 1862. It consists of throwing a *caber*, a straight log, stripped of bark, usually about 13 to 18 feet long, so that it pitches on its tip with enough force to topple over away from the thrower. The caber is held vertically against the shoulders with the small end in the hands and the big end straight up in the air, and the toss is made after a run of 10 to 20 yards. The word caber comes from the Gaelic word *cabar* (pole or spar).

Lawn tennis

One of the most popular of all games is lawn tennis. It is thought to have descended from a game played by the Ancient Greeks, via 'real' tennis, which is played in a special walled and roofed court, with rather different rules from lawn tennis.

Lawn tennis is played on a court 78 feet long, and 27 feet wide for singles or 36 feet wide for doubles. The court is divided in half by a net. The players – there are two for singles or four for doubles – stand on opposite sides of the net and hit a cloth-covered ball across it to each other with a racket strung with gut. If a player is unable to return the ball his opponent gains a point, and if he hits it so that it bounces outside the court, or into the net, his opponent also scores a point.

Table tennis

Table tennis is an indoor game that was invented in Britain. There is an early reference to a similar type of game, played with a cork ball, in 1881, but the introduction of table tennis as we know it, played with a celluloid ball, is generally credited to James Gibb in 1899.

As the name suggests, table tennis is not unlike a miniature, indoor version of lawn tennis. A small, white celluloid ball is hit with a bat over a net on a table. Either two or four people can play at once. During play each player serves five times – that is, until five points have been scored. The winning score is 21, and if each player gets 20, it is the player who scores the next two successive points who wins.

Badminton

The game of badminton takes its name from Badminton Hall in Gloucestershire, the seat of the Duke of Beaufort, where it was first played in the 1860's. Not long

Previous page: Some sports which come under the heading of Athletics: weight lifting, sprinting, pole vaulting, and throwing a javelin.

KNOWLEDGE **NEWS**

Week beginning 30th June 1963

VICTORY!

Hardrada and Tostig lie dead at Stamford Bridge – a fitting end for an aggressor and a traitor

September 26th, 1066

It's true – we've won! It's a victory with a capital of capital Vs – the greatest since Ethandune. Norway's mighty war lord Harold Hardrada and the traitor Earl Tostig are dead. Their army – at least what is left of it – is limping home with its tail between its shaking legs: battered, kicked, humiliated, taught a lesson that it will never forget. Long live the Kingdom of England! Long live Harold, the greatest king since Alfred! Traitors and foreign aggressors beware! The leopards of the House of Godwine have sharp teeth!

England's hero – King Harold

HERE is the story of yesterday's victory. Its glory will last as long as the kingdom of England.

Harold was in the south when he heard that his traitorous brother, Earl Tostig, and Harold Hardrada, King of Norway, had landed. Tostig had come for revenge; Hardrada, his ally, for plunder.

Harold immediately marched north. During this lightning march he heard of the defeat of the English Earls Edwin of Mercia and Morcar of Northumbria. But he pressed on.

Only two weeks after hearing of the Norwegian landing, he came upon their forces at Stamford Bridge, seven miles from York.

The seven-foot Hardrada was so tall that he was the first to see Harold's approach. He formed his men into a half-circle with shields facing outwards. Behind this grim wall of Scandinavian shields he stood holding the sword which two normal men were not capable of lifting. Above him was unfurled his sinister banner, the Land Waster, showing the head of a fierce black raven. This banner had never looked upon an unsuccessful battle.

A messenger from Harold went through the Norwegian lines. He offered Tostig a third of the English kingdom if he would abandon Harold Hardrada and come over to the side of Harold of England. 'And what,' replied Tostig, 'shall be given to my ally the King of Norway?'

'Seven feet of ground or as much more as he is taller than ordinary men.'

This was the signal for the battle to begin. The Scandinavian invaders under Hardrada, together with Tostig's supporters, were encamped on both banks of the river Derwent. In the first charge of the battle Hardrada fell dead, and in a panic his troops rushed across the narrow bridge over the Derwent to join their companions on the left bank. The English prepared to follow, but a Norwegian soldier, with a mighty axe, stood alone on the bridge, and held it against the might of Harold's English army. Forty times he swung his axe and 40 Englishmen fell. Then a brave English warrior got into the river, crept under the bridge, and with his spear slew the Norwegian through the planks of the bridge. Tostig himself fell soon after this. Despite heavy losses on the English side, the invaders were smashed and fled back to their ships. The battered remnants were soon sailing for Norway.

Three hundred ships had brought Tostig and Hardrada's men to England. Twenty-four were enough to carry back the survivors.

Now it's a threat from Normandy

COMMENT

There's nothing wrong with our church

THE Pope says our church is unreformed – but he should remember that only 20 years ago there were three men claiming to be Pope, and the German Emperor had to come over the Alps to sort out the mess. The Pope should also note that when the Papacy was badly in need of reform in the 10th century, we had one of the most go-ahead churches in Europe. Before he starts criticising us, he should think of St Dunstan, St Ethelwold, and St Oswald.

The Pope has also excommunicated our king. He has done so purely because of the testimony of a Viking, William of Normandy, whose ancestors a few generations ago were pillaging God's Holy Church, and who himself was excommunicated some time ago for marrying his cousin. Just because William *said* that Harold swore an oath to acknowledge the Norman's succession to Edward the Confessor – is that a reason for excommunicating him?

There's nothing wrong with our government

THERE are some who say that our kingdom is weak and backward. Nonsense! Possibly in the days of the great Earls, Siward, Godwine, and Leofric, the kingdom was divided and central government was weak. But now we have Harold at the helm. And anyway, look at the rest of Europe. The King of France, Philip I, hardly dares move outside his island in the Seine into his own demesne. Ask them in Aquitaine if they obey the so-called King of France – they probably do not even know his name. And as for the kings of Germany, with their pretentious title of Holy Roman Emperor, they are neither Holy, Roman, nor in the true sense Emperors. The Germans are still a lot of tribes, and still think of themselves as Bavarians, Saxons, and Suabians, and not as members of an empire. There is more culture in one Italian city than in the whole of Germany. As for the Irish, there are enough kings there to fill a regiment of house-carls. There are some who criticise the social organisation of the country. Let them go and read the *Rectitudines Singularum Personarum*. They will see how well organised is a typical English estate, and how intelligently allotted are the duties of the different classes.

Our army is as good as any

AFTER Stamford Bridge our army has been proved to be a match for any in the world. Harold Hardrada was one of the greatest war lords of his time. Our Harold's forced march to Stamford Bridge and ensuing victory must compare as a military achievement with the greatest in the world's history: Marathon, Thermopylae, Mons Bodonis, Ethandune and Lechfeld. But no one in their right mind would say that all is well with our army. The Fyrd, England's home guard, is very much an amateur force. Though the hearts of our men are of oak, they are not trained fighters, nor can they stay in the field for long campaigns. Something also has got to be done about reorganising the service of the thegns, our military aristocracy. In some parts of the country we do know that each five hides of land must produce one fully equipped thegn for the royal service – but this arrangement does not seem to be very widespread.

The reorganisation of our national defence is vital, as the Norse threat is by no means ended. Over the Channel, William waits. But we have a leader of the stamp of Alfred to keep him at bay. In the brief nine months of his reign, Harold has shown himself as a ruler of genius. Long live King Harold!

Over the Channel 'the Conqueror' watches and waits

TOSTIG and Hardrada are dead, but King Harold may soon have to face a new invasion – this time from across the Channel. William, Duke of Normandy, nicknamed 'the Conqueror', is said to have a fleet of nearly 3,000 ships waiting on the Normandy beaches for a favourable wind to blow them to England. Harold has been expecting invasion from this quarter for many months, and throughout the summer his fleet has patrolled the Channel. Three weeks ago the patrol was disbanded in order to release the sailors for the harvest. With the English fleet disbanded and the army weakened by recent battles, many expect William to attempt his invasion in the very near future.

William, Duke of Normandy – he hopes to add a kingdom to his dukedom

ST PETER'S TOOTH AND HAIR TO AID NORMAN INVASION EFFORT

William of Normandy's followers pay homage to the consecrated banner given to him by Pope Alexander II. William proudly points to the banner with his sword. On his right is his half-brother Odo, Bishop of Bayeux, and next to him is Lanfranc of Bec, whom many Normans are tipping to become Archbishop of Canterbury should William ever gain the English throne

POPE ALEXANDER II has given William of Normandy a banner, and a ring containing a hair and tooth of St Peter, as tokens of his support. He has also entrusted William with a Papal Bull promulgating Harold's excommunication. William's claim to the English throne has the full backing of the Pope; and it is thought that if William should land, some priests in England may be torn between loyalty to the Pope and loyalty to the King.

Pope Alexander has accepted William's story that in 1051 King Edward the Confessor promised that he should succeed him on the English throne, and that two years ago Harold himself promised, when in Normandy, to help the Duke to do so. The Norman duke has rejected Harold's counter claim that on the death of King Edward he was chosen as king by the English people in a session of the 'Wiseman's Council' or Witenagemot.

The Pope's decision is causing some anxiety in England where it is thought that the presence of Stigand as Archbishop of Canterbury is largely responsible for the Pope's attitude. Stigand's appointment has not been formally approved in Rome, and he has been excommunicated by both the present Pope and his predecessor. He became Archbishop when Robert was driven from Canterbury in 1053 after antagonising Earl Godwine, King Harold's father.

KING ORDERS BROTHER'S BODY TO BE RECOVERED

TOSTIG'S body has been recovered from the battlefield by order of King Harold. Harold was clearly reluctant to fight against his brother, and has stated that he wishes to supervise a special burial for Tostig.

Ever since Tostig was banished last year, the family split has caused grief on both sides. The Northumbrians had expelled Tostig as their earl, and installed Morcar, brother of Edwin of Mercia, in his place. Harold, then Earl of Wessex under King Edward, refused to help his brother regain his position, and advised the King to banish him. Since then, Tostig has made two attempts to revenge himself. The first was when he landed in Kent, and later ravaged the country around Lindsey before he was beaten off. The second, in alliance with the King of Norway, ended in disaster at Stamford Bridge.

AMERICAN RAILWAYS

STEAM railways were a British invention, introduced in 1825. They spread rapidly all over the world, but nowhere was their development as great as in the United States, where roads were bad and distances were great, and the entire nation was in a hurry to expand westwards.

The first American railways

In 1830, a newly formed company, the Baltimore and Ohio – which is still one of the biggest railways in the United States – operated a passenger service, using a tiny, odd-looking engine called *Tom Thumb*. The same year, the South Carolina Railroad (the American word for railway) began service with its steam locomotive *Best Friend*.

The United States had great forests which provided cheap fuel for the wood-burning furnaces of early engines, ample rocks for track foundations, and ample iron ore for rails. Soon railways linking cities and rivers were springing up everywhere. At first they were small and primitive; 95 railways ran only for an average of 40 miles each, and their tracks were built in different gauges or widths. Early travel on them was painfully uncomfortable. Charles Dickens, visiting the United States in 1842, described American railways as follows:

'*There is a great deal of jolting, a great deal of noise . . . The cars are like shabby omnibuses . . .*'

But as railways were so vital to national growth, service and equipment were speedily improved. Powerful oil-lamp headlights were developed for night travel, and engines became larger. Old canals were drained and the railways were laid along them. By 1850 more than 9,000 miles of track were down. By the time of the Civil War in 1861, the United States had more than 30,000 miles of track.

Many railway bridges had to be built to cross the rivers and steep gorges. John Roebling, the engineer who later built the Brooklyn Bridge, designed a great suspension bridge to carry trains over the Niagara river in the 1850's. In its day it was almost as great an attraction for sightseers as the Niagara Falls.

Plans for a railway to cross the entire American continent

But it was in the expansion of the frontier that American railways played their most important role. The Gold Rush brought 100,000 people to California in 1849 and many thousands more to the rich, undeveloped Oregon Territory. By then, several railway lines went as far as the river Mississippi, but from there on the trip west had to be made on foot, on horseback, or by covered wagon. Even before the Gold Rush, there had been public clamour for a railway to cross the entire continent, although to many people this seemed like a far-fetched dream. In 1848 a newspaper, the *New York Herald*, commented: '*This whole project is ridiculous and absurd. Centuries hence it will be time to talk of such a railroad.*'

But there was no stopping the 'ridiculous and absurd project'. The Secretary of War in 1853 was Jefferson Davis, who later became president

MOTHERS LOOK OUT FOR YOUR CHILDREN!
ARTISANS, MECHANICS, CITIZENS!
When you leave your family in health, must you be hurried home to mourn a
DREADFUL CASUALITY!
PHILADELPHIANS, your RIGHTS are being invaded! regardless of your interests, or the LIVES OF YOUR LITTLE ONES. THE CAMDEN AND AMBOY, with the assistance of other companies without a Charter, and in VIOLATION OF LAW, as decreed by your Courts, are laying a
LOCOMOTIVE RAIL ROAD!
Through your most Beautiful Streets, to the RUIN of your TRADE, annihilation of your RIGHTS, and regardless of your PROSPERITY and COMFORT. will you permit this! or do you consent to be a
SUBURB OF NEW YORK
Rails are now being laid on BROAD STREET to CONNECT the TRENTON RAIL ROAD with TRENTON and BALTIMORE ROAD, under the pretence of constructing a City Passenger Railway Yard to Fairmount!!! This is done under the auspices of the CAMDEN AND AMBOY
RALLY PEOPLE in the Majesty of your Strength and forbid
THIS OUTRAGE!

The famous railway bridge over the Niagara Falls, built by John Roebling and opened in 1855

of the Confederacy. He had five different surveys made to find the best route for a railway from the Mississippi to the Pacific.

Plans and surveys went on all through the American Civil War. The backers of two different railways were finally authorised to begin building, each heading towards the other, one from California, the other from the east.

In Sacramento, California, in January 1863, the first ground was broken for the tracks of the Central Pacific Railroad that would extend eastwards for 1,000 miles. Many experts thought the project foolhardy, if not downright impossible. A track would have to be cut through the granite of the Sierra Nevada mountains; it would have to climb to heights of 7,000 feet, to go through passes where 50 feet of snow fell in winter; gorges and canyons would have to be filled with millions of tons of earth; building crews would have to work and live in the scorching desert wastes of Nevada and Utah.

The railway heading west, the Union Pacific, faced equally hard problems. It started at Omaha, Nebraska, and passed for 1,000 miles through hostile Indian country, then across treacherous parts of the Rockies. Its crews were menaced by Indian warriors, wolves, and coyotes.

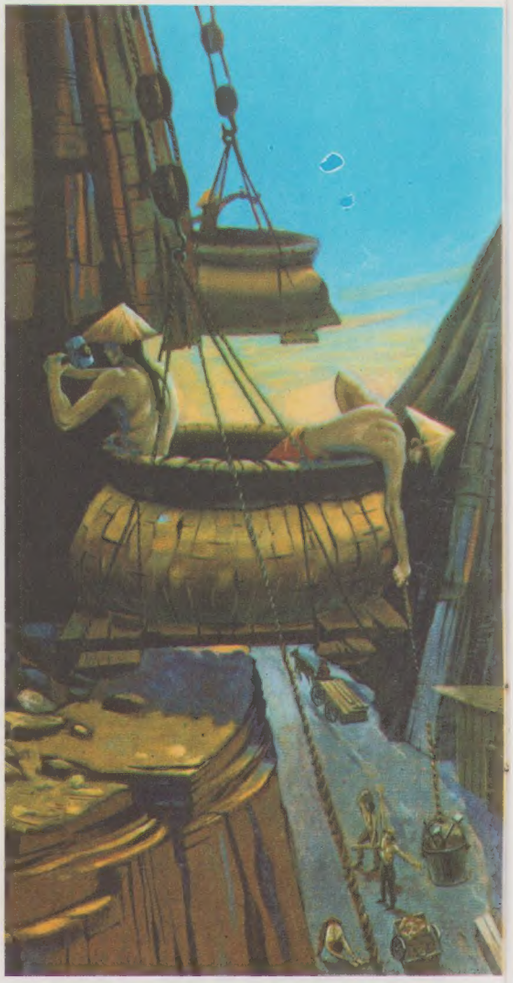
East and west are joined

The line eastwards was built mostly by Chinese labourers. Many of them were brought over under contract from China. The superintendent who hired them said: 'If they could build the Great Wall of China, they can build this railroad,' and they did. They wore coolie dress and pigtails, and lived on their customary meagre diets of dried cuttle-fish, bamboo sprouts and seaweed. They worked without complaint for pitifully low wages. Many of them died of sunstroke or exposure or were killed in blasting accidents.

Opposite them, on the westwards-driving Union Pacific line, were mostly Irish immigrants, strong, tough labourers from Chicago, New York, and Boston. As the two separate building crews approached each other, there were contests to see which could lay the most track in a given time. The Chinese once put down 10 miles of track in a single day.

On 10th May 1869 the two railway systems met at Promontory, Utah, a desert outpost. Dignitaries made speeches and drove in the last spike – the famous Golden Spike made of California gold. Word was sent by telegraph to the outside world. In Washington, a magnetic ball above the Capitol was dropped to signal the news. Cannons were fired in San Francisco. All over the country, church bells were rung. At last, the east and the west were joined together.

Now began the great era of westward expansion by train instead of by covered wagon or ship. Branch lines were built in many places to link up with the great trans-continental line.



Suspended in baskets, Chinese coolies chip away cliffs to make paths for the tracks

After the American Civil War railways played an important part in transporting cattle from the cattle centres of the west to the east

Track layers meeting opposition from a band of Indians

Long freight trains carried farm machinery and manufactured goods as well as passengers to the frontier areas.

The new railways brought about a huge increase in cattle-raising. This was the hey-day of the American cowboys, who drove great herds from the Texas range northward along the famous Chisholm or Western Trails to the cattle-car yards of Dodge City, or Abilene in Kansas.

The railway companies promote settlement in the west

Railways require strips of land, known as right-of-ways, along which their tracks run. The government gave the railway companies tremendous gifts of free land, out of the Public Lands, to encourage further expansion. Often these land grants extended for 25 miles or more on each side of the tracks. Within only two years of the opening of the trans-continental line, western railways owned land grants amounting to three times the size of New England – over 150 million acres! It was theirs to sell and, naturally, they used it to increase their business.

Railway-land advertisements became a familiar sight on notice-boards and in newspapers, not just in the big cities of eastern America, but all over Europe. Special agents were hired in Europe by the various railways to promote emigration from Great Britain, Ireland, Germany, Poland, the Scandinavian countries, and even from tiny Iceland. Families still living in the Old World were offered farmland in Kansas, Nebraska, the Dakotas – places they had probably never heard of – at prices ranging from half a dollar an acre to five dollars an acre. The land was tax-free and was sold on credit; that is, it would not have to be paid for until the buyers had lived on it and developed it.

European immigrants travelling westwards in response to railway advertisements for cheap farm lands

The main purpose of the railway companies in doing this was to provide passengers for their trains, and to populate regions where only empty wilderness and prairies existed. They were making sure that in the years to come western America would be a flourishing region in need of trains to carry its citizens and the goods necessary for their comfort to and from the rest of the continent.

Westward emigration

Attracted by the possibility of owning land at little cost families of every nationality poured west and north-west. They jammed the station platforms; they crowded into the old coaches, carrying their bedding, furniture, and tools, sometimes even bringing young trees from the Old Country along with them; sometimes a single family of grandparents, children, and many grandchildren would take up an entire carriage.

Many of the railway advertisements that lured them west were false and exaggerated. Newcomers to one farm area in California, described as a 'garden spot' by the railway, bitterly nicknamed it Starvation Valley. In many cases, too, the railway officials had used bribery to obtain their huge grants of land. But in general the railways performed a valuable service to the country by attracting so many newcomers to the frontier.

Sometimes several railways competed for passenger traffic, and there were price wars. One of the most famous took place in 1887, when the standard fare from Kansas City to Los Angeles was the equivalent to £100 today. The Santa Fe Railroad, hoping to take business from the Southern Pacific, began reducing its fare. Each line set a new low rate until finally, one day, the Southern Pacific offered a bargain trip across the continent to California for exactly one dollar!

By 1900 there were more miles of track in the United States than in all of Europe. Nowadays, with road and air travel constantly increasing, railway traffic, both of passengers and freight, is no longer at its peak. American railways still carry well over 200 million passengers every year, but, as in Great Britain, there are many empty carriages on most of the long-distance journeys.

ROBERT KOCH

OF the 13 children whom the mining engineer Hermann Koch and his wife Mathilde brought up in their home in Klausthal in Hanover, Robert, born in 1843, was the most thoughtful. Success at school led him to the faculty of medicine in the University of Gröttingen, where he qualified as a doctor in the year 1866. After graduation he served as a surgeon in the Prussian army, and then as a general practitioner in the town of Wollstein in eastern Germany. Life in Wollstein was anything but exciting, but the young doctor never became bored. He converted part of his house into a simple laboratory, and here, with his microscope, he made a discovery that was to make him famous throughout the world.

THE ANTHRAX BACILLUS

At that time there were frequent outbreaks among the herds and flocks of European farmers of a disease known in England as anthrax. This terrible disease was so virulent that even the strongest of cattle and sheep sickened and died within hours, and no treatment was of the slightest use. For several years it had been suspected that this deadly disease was due to an infection by bacteria, but nobody had ever been able to provide the certain proof that this was so. Koch took some samples from animals sick with anthrax which he injected into some house mice kept in cages in his laboratory. Soon the unfortunate mice became ill, and when Koch killed them he found that, in turn, their tissues were able to infect yet more mice. In this way he was able to transmit anthrax through 20 consecutive batches of mice. At the same time he took out little bits of the spleens of the sick mice, and, under his microscope, saw the deadly bacteria growing in the fragments of mouse tissue.

By 1876 Koch had convinced himself that there, under his microscope, was the cause of anthrax. Greatly daring, he wrote to the Professor of Botany at Breslau, Ferdinand Cohn, and asked if he might demonstrate his discovery. The Professor agreed, and after the demonstration he too was convinced that the bacteria were, indeed, the cause of anthrax. This was the first complete proof that bacteria could cause disease in animals, and therefore, probably, in humans too.

Koch was famous overnight. He gave up his practice and devoted his time to research.

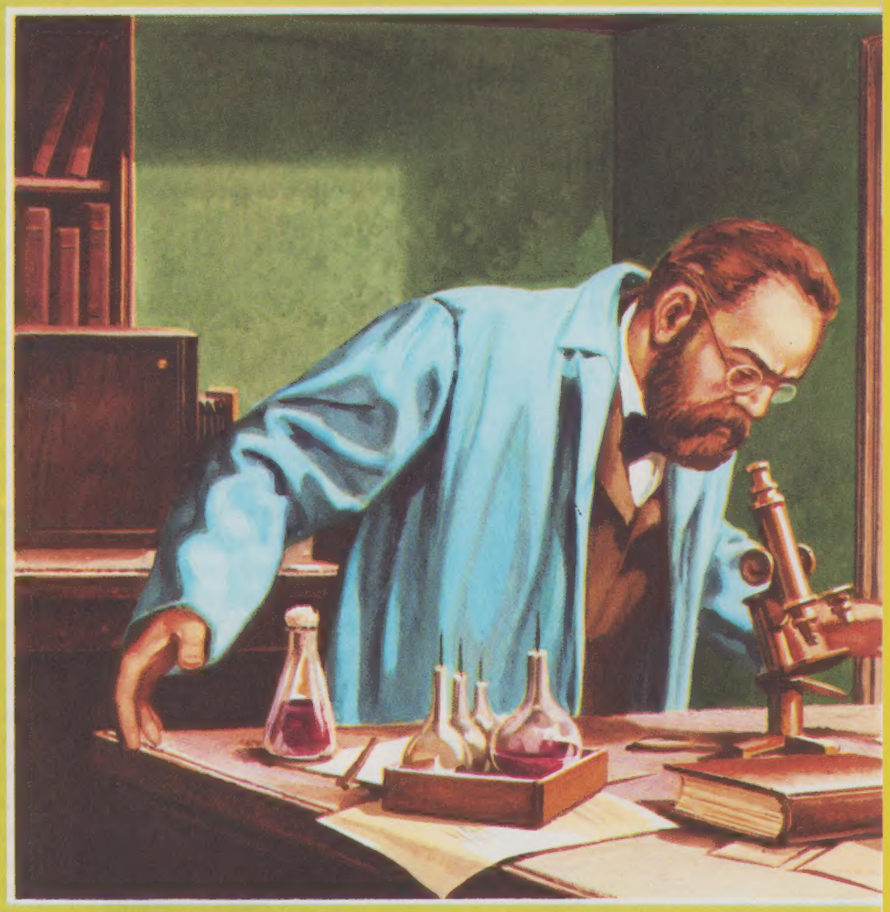
Robert Koch (1843–1910)

THE MAGIC JELLY

Although for many years scientists had been able to keep bacteria in their laboratories, they had almost always found it necessary to grow their cultures in liquid media.

Meat broth, infusions of hay, and milk were the media that were most often used. Satisfactory growth was obtained in this way, but the great disadvantage of a liquid medium was that in it bacteria of many sorts grew mixed together. It was almost impossible to separate them and obtain a culture which contained bacteria of only one kind.

Koch solved this problem in a most ingenious way. He dissolved a little gelatin in warm meat broth to make a mixture that he called 'nutrient gelatin'. As the mixture cooled he poured it on to a flat piece of glass and allowed it to set. When the nutrient gelatin was firm he took a platinum wire, dipped it into one of his liquid cultures, and then drew it gently across the surface of the film. As he did so invisible bacteria rubbed off the wire on to the gelatin, and where they fell each began to form a bacterial colony.



Robert Koch examines a specimen under his microscope

Soon the colonies became visible, and Koch, knowing that each had grown from a single organism, was certain that each contained only one kind of bacteria. With his platinum wire he picked off the kinds that he needed in *pure culture*.

It is interesting to recall that in the next step he was helped by Frau Hesse, the intelligent wife of one of his assistants. Hearing that the nutrient gelatin could not be incubated at body temperature (37°C) without melting, she suggested that agar-agar should be used instead, a suggestion for which bacteriologists are grateful to this day.

TUBERCULOSIS

Like anthrax, tuberculosis was thought to be an infectious disease, though nobody had ever been able to prove that this was really so. On 24th March 1882 Robert Koch startled the world by announcing to the Physiological Society of Berlin that he had found the bacterium which was responsible for this unpleasant illness. By taking fragments of tuberculous tissue from diseased humans and animals, and by staining them in a special way, he had been able to see the tubercle bacilli lying in the diseased tissues. What is more, he had, after a great deal of difficulty, grown these bacilli in tubes containing solidified blood-serum. He had even transmitted the infection to rabbits and to guinea-pigs.

Eight years later, in 1890, Koch announced that he had discovered a substance which could be given as injections to stop tuberculous infections.

while a patient waits to see him in his surgery

By treating cultures of tubercle bacilli with glycerin he had been able to prepare an extract which he called *tuberculin*. Unfortunately tuberculin proved not to be the wonderful therapeutic (curative) agent that was hoped for, but as an aid in the diagnosis of tuberculosis it has been invaluable. Large amounts of a very similar substance are used today in the Mantoux Test for tuberculosis, with which many schoolchildren over the age of 13 are familiar.

During his work on tuberculosis Koch found that there were two sorts of tubercle bacilli. One kind he found in human tuberculosis of the lungs, and he realised that this kind caused an infectious disease transmitted from one human to another. The other kind he found in cattle, and he rather underestimated the frequency with which it caused tuberculosis in humans who have consumed milk from tuberculous cows.

A VISIT TO EGYPT

In August 1883 Koch left his researches in Berlin and travelled to Egypt to study the outbreak of Asiatic cholera there. So infectious and lethal was this disease that there was plenty of material for him to work upon, and early in 1884 he was able to report that he had discovered the bacterium which caused it.

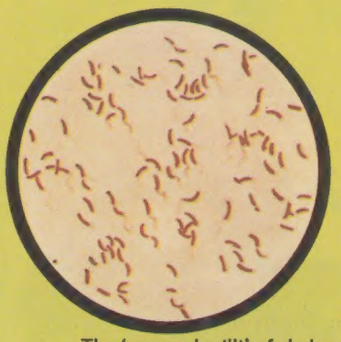
Koch noticed that in liquid culture the bacteria of cholera, unlike the bacteria of anthrax or tuberculosis, were able to swim about very actively. Their shape, too, was rather unusual in that each was a short little rod, slightly curved to give it the appearance of a comma.

Koch did not return straight home from Egypt, but went on to India to study cholera there. It was a great success when he was able to show that he could isolate a bacterium from cases of cholera in India which was just like the one he had found in Egypt. He arrived home in May 1884, and in the next year became Professor of Hygiene and Bacteriology in the University of Berlin.

THE BACTERIA

Anthrax bacilli

Tubercle bacilli



The 'comma bacilli' of cholera

THE LAST YEARS

Besides the discoveries for which Robert Koch is so rightly famous, there were many more scientific activities to which he gave his attention. A visit to East Africa to investigate the dreaded sleeping sickness, lectures to scientific societies in countries as far apart as Britain, America, and Japan, and latterly his duties as Director of the Institute for Infective Diseases in Berlin, all made great demands on him.

It is not surprising that he had little time left for his family. Frau Koch, whom he had married soon after graduation, wearied of this neglect, and in the end a divorce was arranged. The worthy citizens of Berlin were greatly dismayed to find their scientific hero less than perfect, and they expressed their displeasure by removing the commemorative plaque they had placed on the front of his house. But a greater shock was in store. In his old age the great scientist remarried, this time a beautiful young woman called Hedwig Freiberg. It was she who cared for him in his later years, who accompanied him on his long journey to Japan, and who was present at Baden-Baden on 27th May 1910 when Robert Koch breathed his last.

THE TIBETANS

'THE centre of high snow mountains; the source of great rivers; a lofty country, a pure land.' So a Tibetan poet of the 9th century described his country. The mountains which surround the 500,000 square miles of Tibet are the highest in the world, and they enclose the sources of the greatest rivers in Asia – the Indus and Brahmaputra in the south-west, the Yangtse, Mekong, and Salween in the north-east. The north-easterly approach to Tibet is the least difficult, but once inside, there is no easy way out of the encircling mountains. For this reason Tibet has never been a through route for migrating peoples or conquering armies. Lack of communications has preserved its seclusion until the last 10 years, so that the Tibetans kept their independence, their traditions, and their national character. Before the Chinese invasion in 1950 no wheeled vehicles were used, and transport depended on riding and pack animals. Roads were usually rough, narrow tracks, and there were no bridges across the larger rivers. These rivers are only navigable for short stretches, and the only type of boat, apart from wooden ferry barges, was the yak-skin coracle which could only be used for journeys downstream. Contact with India, which was not far distant from Tibet in actual miles, was made difficult by the barrier of the Himalayas, but a few people did cross by the mountain passes, and the two countries never lost touch.

The geographical situation of Tibet

Since 1952 the Chinese Communists have built hundreds of miles of motor roads. Lhasa, the Tibetan capital, is now linked with China by two main roads which more or less follow ancient trade routes, and another road links Lhasa with Sinkiang. Airfields have been made near Lhasa, in central Tibet.

A typical Tibetan

Most of Tibet is a wilderness of mountain ranges and plains rising to 16,000 feet or more above sea level, uninhabited or scattered with nomadic herdsmen. The southern region contains river valleys and cultivated land from 9,000 to 15,000 feet. Very little except grass grows on the uplands, but in the valleys barley, wheat, peas, and beans are grown, and willow, poplar, walnut, and apricot trees.

It is difficult to find out much about conditions in Tibet under the Chinese. Before the invasion the annual yield of crops used to be greater than the people needed for food, and there was a grain reserve sufficient for three years, supplemented by large flocks of sheep and herds of goats and yaks which supplied milk, butter, cheese, meat, and wool.

The population of Tibet before the Chinese invasion

A religious procession. In the background is

was about 3 million, made up of herdsmen, peasants, nomads, villagers, nobles, and everywhere monks and lamas.

The people

Tibetan aristocrats, and the nomadic tribes of the north and east, are tall, long-limbed, and long-headed, with clear-cut features. The villagers in the fertile valleys of central and south-western Tibet are shorter, round-headed, with high cheek-bones, and flat noses. All Tibetans have straight dark hair, dark eyes, and olive skins. Tibetans are kindly, cheerful, honest, and contented. They are intelligent, self-reliant, with a sense of humour; they enjoy their leisure and have naturally good manners. The nomadic tribesmen, the

A nomad's tent. In the foreground is a yak, a patient animal rather like a North American buffalo

Amdowas and Khampas, are more warlike and excitable than the peasants who live in villages.

Tibetan painting, wood-carving, and metal-work is often beautiful and shows great skill and craftsmanship; works of art are traditional and nearly always religious. In architecture, too, building techniques are skilful, and design, as in the Potala Palace of the Dalai Lama, can be majestic and impressive. Most houses have strong towers with square bases and terraced roofs, often with two or three floors; the living-rooms are above and the stables and store-rooms below. Herdsmen live in tents made of black yak-wool and clay.

Buddhism

The thoughts and actions of every Tibetan in every walk of life are influenced by their religion, a special kind of Buddhism brought from Nepal, India, and China in the 7th century. For over 300 years Church and State in Tibet were identical for all practical purposes, and lamas ruled the country. Almost every family had one member who was a monk; the title *Lama*, meaning 'exalted' or 'superior', is given to the leading priests. There were about 3,000 monasteries, owning about a third of the cultivated land, before the coming of the Chinese, and between 250,000 and 500,000 monks.

Feudal society

Tibetan society before the Chinese Communists took over was feudal but not oppressive. Everyone respected custom, which can be a safeguard against tyranny. The guardian of custom was the Dalai Lama to whom every Tibetan had the right to appeal. All land was supposed to belong to the State, from which landowners and monasteries held their lands. The landowners paid rent to the State in produce and in service as government officials. The monks performed rites and offered prayers for the welfare of the State in return for their lands.

Two-thirds of the people worked for landowners or monasteries on the land, earning no wages but receiving food, grain, and a share of the crops. They held some land of their own, but had to provide services like transport by pack animals, work on the roads, and service in the army. Most peasants could not leave their land without permission of their employers. Want and destitution in Tibet were very rare. The people were sturdy and enduring, as they had to be in such a severe climate, and in spite of their few comforts they lived better than people in many other parts of Asia. There was no great gulf between rich and poor, for the wealthiest Tibetan noble was far poorer than a fairly well-off businessman in Calcutta or Bombay. Tibetan exports of wool, skins, and borax brought foreign exchange to pay for tea, porcelain, and silk from China, and rice, sugar, textiles, and metals from India.

The Dalai Lama, who is considered to be the reincarnation of the Lord of Compassion, was supreme temporal and spiritual ruler of Tibet. He governed through two separate civil services of specially trained monks and hereditary nobles, who carried out his instructions and kept him informed of events.

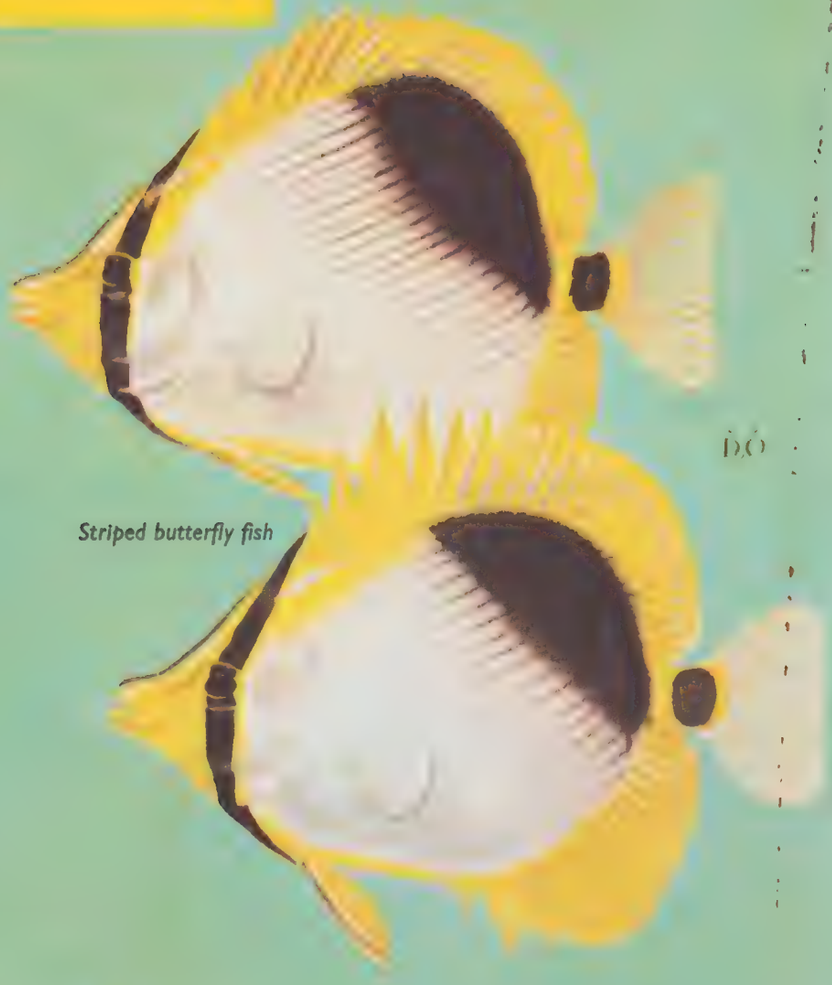
the great Potala Palace. The lamas wear vivid clothes, and even the branches of the trees are decorated

Chinese occupation

Today Tibet is ruled by the Chinese Communists. To a certain extent they have brought benefits by building roads and bridges, and introducing improvements in farming, stock-breeding, and forestry. But the influx of Chinese exhausted Tibetan grain reserves and caused scarcity of food and soaring prices for the first time in history. From the time they occupied Tibet in 1950, the Chinese did all they could to undermine the power of the Dalai Lama and the monasteries; their rule grew increasingly oppressive and hostile to religion, and in 1956 Tibetan guerrillas led a revolt which continued till 1959. In that year the Dalai Lama fled to safety in India, but Tibetans still hope for his return one day.

CURIOUS FISH

Long-nosed butterfly fish



Striped butterfly fish

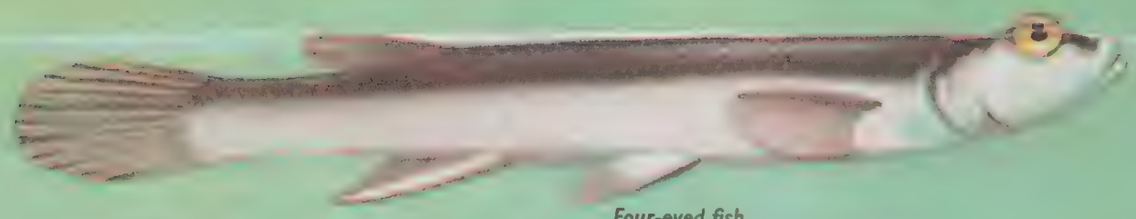
MOST of the familiar examples of interesting habits and behaviour among animals are taken from the mammals, birds, and other land-living creatures. We generally regard fish as pretty (when seen in an aquarium) or good to eat, but not of great interest otherwise.

Nevertheless fish have to be adapted to escape their enemies, obtain their food, and reproduce their kind, just like other animals. These adaptations may be of form and colour, or of habits; when you have read this article you will agree that some of them are very strange and unexpected indeed.

Many kinds of butterfly fishes live among coral reefs in the tropics; they are among the most beautiful and brightly coloured of all fish. In some of them the eye is crossed by a black stripe, which partly conceals it, and on the hinder part of the fish there is a dark spot, looking rather like an eye. When a carnivorous fish tries to catch another fish, it allows for its victim's dash to safety by aiming a little in front of it. It is thought that the enemies of the butterfly fish may mistake its tail for its head and so be led to aim behind rather than in front of it. In this case the forward dart of the fish will take it out of, instead of into, its enemy's jaws.

Archer fish

The archer fish (*Toxotes*) lives in river mouths in far eastern tropical countries, and has a most extraordinary method of capturing its food. It swims at the surface of the water, looking out for insects sitting on overhanging grass or leaves. When it sees one it spits a rapid succession of drops of water at it. Its aim is very accurate and the insect is nearly always knocked off its perch and falls into the water, where it is seized by the fish.



Four-eyed fish

The four-eyed fish (*Anableps*) is found in tropical Central and South America. Each eye is divided into an upper and a lower half. The lens of the upper half is adapted to seeing in the air and that of the lower half to seeing under the water. The fish always swims at the surface with the upper half of its eyes out of the water, and in this way it can keep a look-out at the same time for such enemies as fish-eating birds in the air and larger fishes swimming below. In order to keep its eyes moist it is necessary for it to duck its head under the water at frequent intervals, and it sometimes dives down to seek for food.

Cowfish

The cowfish (*Ostracion cornutus*) is covered all over with an armour of bony plates, and over each eye it has a long, sharp horn. It can only swim very slowly, but this does not matter, as no enemy could swallow a cowfish without severely injuring itself. Besides being so well protected, this is one of the strangest-looking fish in the sea.

'Fish out of water' is a proverbial expression for a person in an uncomfortable situation, but the little mud-skipper (*Periophthalmus*) spends a large part of its time out of the water. Mud-skippers live in the tropical mangrove swamps, and during the low-tide period they crawl and hop about on the exposed mud. Their front or pectoral fins are modified to serve as legs, and they have an air-breathing organ as well as the gills which fish normally possess.

Mud-skipper

The sea-horses (there are several different kinds of them) are extremely odd-looking little fishes. Their breeding habits are even stranger than their appearance.

The *male* sea-horse develops a sort of pouch on its stomach, rather like that of a female kangaroo. At the time that the eggs are laid and fertilised the female passes them into the pouch of the male through a small opening in it. They hatch after about eight to ten days, and the baby fish then remain in the pouch for a little while, actually getting nourishment from their father's blood-stream. When they are sufficiently developed to be 'born' they are ejected from the pouch into the water and swim away on their own. In the sea-horse the father takes over a great part of the role usually played by the mother in animal reproduction.

Sea-horses live among seaweed, holding on to it by curling their tails round the stems. They can only swim very feebly, and they seldom venture into open water. Only one kind, the common sea-horse, is found in British waters. It is abundant in the Bay of Biscay and sometimes reaches the south-western coasts of Britain.

Sea-horse

In the sea cat-fish (*Galeichthys felis*) it is again the father who 'mothers' his children. After the eggs are laid by the female he takes them into his mouth. He carries them about for a month or so, and when they hatch the babies continue to live in his mouth for another two weeks. As there may be over 50 eggs (or babies) it is quite impossible for him to feed, and he does, in fact, fast for the whole of this six-week period.

Sea cat-fish

PARLIAMENT

The Houses of Parliament, seen from the south side of the river Thames

THE British Parliament is made up of the Crown, the House of Lords, and the House of Commons. We have already looked at its history, and seen how the different parts came into being (see pages 344 and 356). We will now look at Parliament today.

The House of Commons

The House of Commons is now the most important part of Parliament. It consists of 630 Members (referred to as Members of Parliament or M Ps) who are elected by constituencies, or voting areas.

The election of M Ps takes place either in a General Election, when Parliament has been dissolved and all the constituencies hold elections, or in by-elections, when a constituency's former Member dies, resigns, or becomes a Peer entitled to take a seat in the House of Lords. Every person living in a constituency who is over 21 can vote, unless he is a peer with a seat in the House of Lords, is of unsound mind, has been found guilty of breaking the election laws within the last five years, or is in prison for any serious crime.

Anyone who is qualified to vote can stand for Parliament except: undischarged bankrupts, clergymen of the Churches of England, Scotland, Ireland, and the Roman Catholic Church, and holders of certain offices under the Crown (such as members of the armed forces). Most candidates are adopted by one of the political parties, although some stand as 'independents'. At the moment there are three major political parties in the House of Commons – the Conservative, Labour, and Liberal parties. The party to which most members belong (which has the *majority*) forms the Government. If no party gains an overall majority, agreement must be reached between two or more parties before a Government can be formed.

Inside the House of Lords, looking towards the thrones in the House of Lords Chamber

The House of Lords

The House of Lords is nowadays much less important than the House of Commons. It has no influence on the formation of a Government. It cannot prevent the passing of a Money Bill – a Bill dealing with revenue or expenditure – and its power over most other Bills is limited. A Bill passed by the House of Commons but rejected by the Lords will be granted the Royal Assent after a year's delay. Parliament is supreme in the land, and the House of Commons is supreme in Parliament. It is the supremacy of the House of Commons – of the elected representatives of the people – which makes Britain a democracy.

The members of the House of Lords include the hereditary peers of the realm other than Scottish and Irish peers; the 16 representative Peers of Scotland elected by all Scottish peers; up to nine 'Law Lords' (senior judges); and, since 1958, a number of life peers and peeresses. These are the Lords Temporal. In addition there are the Lords Spiritual, who are: the Archbishops of Canterbury and York; the Bishops of London, Durham, and Winchester; and the 21 other most senior bishops of the Church of England.

Parliamentary procedure

One way and another, Parliament has an enormous amount of business to get through. It has to pass new laws. It has to debate the Government's conduct of foreign affairs. It has to debate the activities of the various Government Departments and the nationalised industries.

In the House of Commons, elaborate rules of procedure have been developed to determine who may introduce a Bill and when he may do so, who may speak at any particular time, and so forth. Moreover, the Speaker of the House of Commons, who is an M P elected by the House of Commons itself to preside over its debates, has powers to enforce the rules of procedure and, where new circumstances arise, to make new rules.

The House of Commons sits for about 160 days in each annual session. The

Looking down on the House of Commons, showing the Members' benches and press and public galleries

'financial year' begins in April. From February to July the House of Commons is largely concerned with authorising the estimates of the money that Government Departments will need to spend during the financial year and the measures proposed to meet this expenditure. These measures are announced by the Chancellor of the Exchequer in his Budget speech, usually in April.

During the rest of the session there are other Government Bills to be debated, and, in general, Government business now dominates the House of Commons. This is not to say that the Government dominates actual debates. In discussions behind the scenes, the Opposition is allowed to select those parts of Government Bills which it wishes to debate.

Some time is always reserved for individual M Ps; most important, a number of Fridays are devoted to Private Members' Bills (M Ps ballot at the beginning of the session for the right to introduce them), and from Monday to Thursday each week there is Question Time. Question Time, which lasts for nearly an hour each day, enables M Ps to get information and explanations from Ministers about the whole range of activities of the Government Departments.

In the House of Lords, which has much less business to get through, the rules of procedure are less rigorous. The Speaker of the House of Lords, who is the Lord Chancellor, has no more authority than any other peer to control debate. If, for example, two peers rise to speak at the same time, the House as a whole decides which of them shall take the floor.

The progress of a Bill

A Bill passes through a number of distinct stages. The 'first reading' of a Government Bill is a formal announcement of its title that precedes its publication. The 'second reading' is the opportunity for a serious debate of the broad principles it embodies. The Bill then proceeds to the 'committee stage' to be considered and amended in detail. To save time, the House of Commons has a number of small standing committees of from 20 to 50 members. These consider different Bills, usually in the mornings, when the House is not sitting. But important Bills are considered by 'Committees of the Whole House'. When it is considering the estimates, the House of Commons calls itself the Committee of Supply. When it is considering the Budget proposals, it calls itself the Committee of Ways and Means. After the committee stage of a Bill comes the 'report stage', when the Bill is formally reported to the House by the chairman of committee. This gives the House as a whole the opportunity to discuss any amendments made by a standing committee. Lastly comes the 'third reading', when a Bill is considered in its final form.

If voting is equal in the House of Commons, the Speaker has a casting vote (which, since he must retain his impartiality, he casts in favour of the Government of the day regardless of party). In the House of Lords, the Speaker has no casting vote: as a general rule, when voting is equal, the 'Noes' automatically have it.

Voting in both Houses is taken by means of a 'division'. Members voting 'Aye' and 'No' go into different lobbies to be counted.

Your member and you

Anyone who has a grievance or who seeks to influence public policy should write to his M P or go to see him at Westminster. It does not matter if he voted against him. It is an M P's duty to represent all those in his constituency. The House of Commons has a large hall called a 'lobby' where M Ps meet people coming to see them. Trying to persuade M Ps to support a particular policy is called 'lobbying'.

If you tell your M P of a grievance, he might see fit to ask the appropriate Minister a question about it, indicating whether he wants a written answer or an answer spoken in the House of Commons at Question Time. If he is not satisfied with the answer he gets, he can ask further questions. Question Time is perhaps the most important single way in which the Government and the Civil Service are held responsible to the people for their actions.

The State Opening of Parliament by the Queen takes place in the House of Lords

The new Speaker's Chair was a gift from Australia

Policemen stand by as Members queue up in the lobby of the House of Commons before claiming seats

In the warm waters of tropical seas, islands are formed by the slow growth of corals, and under the

THE INFLUENCE OF ANIMALS ON THE

ALTHOUGH the life of man is long compared with that of most animals, it is far too short for him to be able to appreciate the great changes that take place on the surface of the land. We speak of something being 'as old as the hills', and indeed the hills are very old compared with a man's lifetime, or even with human history.

Nevertheless, there was a time when the hills were not there. We know that the regions now occupied by the great mountains, the Alps and the Himalayas, were once sea, and areas which are now sea were once dry land. The very high mountains are the newest, not the oldest, ones; the Scottish Highlands, although they are now hardly more than hills, are much older than the Himalayas. Once they were a great mountain range, but in the course of several hundred million years they have been worn down to their present level. Once, thousands of years ago, England was joined to Europe, and a river flowed in the course of the English Channel.

The whole surface of the earth is slowly and constantly changing.

The forces that bring these changes about are mostly those physical processes with which the science of geology is concerned (see page 146): earth movements, volcanic activity, denudation or weathering of the land, and the accumulation of sediments, such as sand or mud, in the sea. Nevertheless, living things play an important part in causing changes on the face of the earth. Both plants and animals are concerned, and in this article we shall consider the ways in which animals break down the land, build it up, and bring about changes in the structure of its surface.

ANIMALS ACT IN THREE WAYS

The three ways in which animals bring about changes on the surface of the earth can be called 'modifying', 'destructive', and 'constructive'. All of them operate very slowly, but they bring about enormous effects in the course of thousands of years.

Modifying action. The animals which work in this way live in the soil, and earthworms are among the most important of them. They occur in enormous numbers; in a field in which sheep or cattle are grazing their total weight is often less than that of all the earthworms under the grass. These worms pass the earth through their bodies, bringing the deeper soil to the surface in the form of 'castings'. Their burrows allow air and water to penetrate the earth. Many insects, such as ants, bring deep soil to the surface in the same way. This modifying action has a very important effect on the fertility of the soil.

Destructive action. On the shore, where the sea is beating against steep cliffs, you will often find the rock riddled with holes. These have been made by molluscs ('shellfish') which bore into the solid rock. Their burrowing makes it easier for the waves to wear away the rock and so encroach on the land. The ones we show are date-mussels (*Lithophaga*).

Constructive action. Many animals living in the sea extract calcium carbonate or chalk from the sea water to make their shells or skeletons. When they die these accumulate and, when raised up by earth movements, form the type of rock known as limestone. The reef-building corals form limestone on a large scale, and we shall speak of them separately in a moment. Another group of animals whose remains go to form limestone is the *Foraminifera*, of which the kind called *globigerina* is one of the most abundant. These are minute creatures belonging to the Phylum Protozoa (see page 552), and their shells accumulate on the ocean floor. There they form a characteristic deposit known as the globigerina ooze. The chalk of south-eastern England is a kind of limestone made up largely of the shells of Foraminifera.

The *Radiolaria*, another group of Protozoa, also form sedimentary deposits, but their shells are *siliceous* in composition – that is, made of flinty material.

Three different animals which respectively modify, destroy, and build up the surface of the land. From above they are: an earthworm; date-mussels burrowing in rock on the sea-shore; a single specimen of a radiolarian, greatly magnified

water the living coral forms many-coloured 'gardens'. Three species of corals are shown separately on the right

LANDSCAPE

Coral reefs

Corals are among the most important limestone-forming animals, and at the present time land, in the form of coral reefs, is being built up in the seas of the tropics. Often these coral islands are in the form of rings, called atolls, and for many years it was a complete mystery why they should have this shape; the puzzle was solved by the great naturalist Charles Darwin, who gave an ingenious explanation.

Many oceanic islands are formed by volcanoes rising out of the sea. Around the edge of such an island coral will grow, forming a fringing reef. If the island then very slowly sinks (or the sea level slowly rises) the coral will grow upwards to keep pace with the sinking, and a circular channel or lagoon will form between the island and the reef, which is now called a barrier reef. Finally the original island disappears beneath the sea, but the ring of coral is maintained at the surface by its continued upward growth and forms an atoll surrounding a shallow lagoon. The coral does not grow above the surface, and the coral island is formed by dead fragments of coral being thrown up by the waves. Coconut palms and other plants establish themselves on the island and soil is formed; many coral islands have quite large human populations. Barrier reefs may be formed off continental shores; the Great Barrier Reef off north-eastern Australia is the outstanding example of this. The three stages in the formation of an atoll from a volcanic island are shown in the diagrams above, which are sections through the island; the original rock is coloured brown, the coral yellow.

Mountains can be formed by very slow earth movements on a gigantic scale, and the rock of which they are made consists largely of sediment that accumulated in past ages at the bottom of the sea. Evidence of this is given by clearly recognisable fossil corals found in the limestones of high mountains.

A peak of the Dolomite Mountains, formed of coral limestone; inset, a specimen of fossil coral

POPE GREGORY VII

Gregory VII lifts the excommunication from Henry IV who has come as a penitent to Canossa

IN 1046 the Holy See was in urgent need of reform. The Pope had claimed for centuries to be the single head of Christendom; but in the 10th and early 11th centuries he sometimes behaved quite unlike a head of the Church, and in 1046 there were not one but three men claiming to be Pope. The chief trouble was that the Popes had to involve themselves in the local politics of Rome. Two great families, the Tusculani and the Crescentii, constantly fought for control of the Papacy. In 1033 the Tusculani set Benedict IX on the papal throne. He was a boy of 10 at the time, and in 1045 he wished to get married (so it was said), and he sold the Papacy to a high-minded Roman who became Pope Gregory VI. Meanwhile the Crescentii had tried to set up their candidate, and when in 1046 Benedict decided to be Pope again, there were three claimants. Benedict was guilty of what the reformers of the time most objected to: the sin of simony – that is, selling Church offices for money, and was in their eyes not sufficiently opposed to clerical marriage. The Emperor Henry VI crossed the Alps and had all three Popes removed; in their place he nominated in turn three German bishops. The first two died; the third, Pope Leo IX, survived, and in five years (1049–1054) transformed the Papacy. He began the movement sometimes called the papal reform, and sometimes the Hildebrandine or Gregorian reform, because its most dramatic figure was Hildebrand, who became Pope Gregory VII (1073–1085). The special aims of the reformers were to abolish simony, lay control over Church offices, and marriage of the clergy, and to make the Pope the effective head of the Church.

Hildebrand da Soana, who became Pope Gregory VII

Disciple of the Saints

In 1046 Hildebrand was a young cleric in the court of Pope Gregory VI; when Gregory was deposed Hildebrand went with him into exile to Germany, where he lived as a monk for a few years; then he returned to Rome with Leo IX. Rome was his old home; he felt himself to be a son, disciple, and servant of its patrons, St Peter and St Paul.

Gregory did not think of Peter and Paul as dead saints, nor even as men who had once lived on earth but now lived in Heaven. St Peter in particular had never – in Gregory's view – ceased to rule the Church of Rome. When a Pope acted, St Peter acted in him; the Pope was Peter alive in the world. This was not a private opinion of Gregory's. In some sense it was held by almost every Christian at the time. But the belief was especially intense and effective in the mind and personality of Gregory VII. His actions were violent; he seemed ambitious and uncontrollable; but when his friends expostulated with him he told them that it was not his own glory which he sought, but that of the Apostles.

Strengthening the Church

Gregory was so sure that God was on his side, and that he must therefore triumph, that he preached crusades against the Church's enemies. It is not only we today who tend to feel that he went too far. Many of his friends and cardinals deserted him in his own lifetime. When he died he was very much alone, and he had been turned out of Rome itself by his chief enemy, the Emperor Henry IV. 'I have loved righteousness and hated iniquity, and therefore I die in exile,' he is said to have exclaimed on his deathbed.

What a strange story it is! Gregory had believed that God would ensure his triumph in this world. He died seeming utterly to have failed. Yet the years following his death saw the triumph of many things for which he had fought; above all the papal supremacy was more widely accepted, and more strongly established than ever before.

Gregory's most bitter enemy was the Emperor Henry IV (see page 773). Each tried to declare the other deposed: Gregory set up another ruler of Germany and the Holy Roman Empire, and Henry another Pope, in the hope of ousting their rivals. In this neither was entirely successful. Gregory twice declared Henry excommunicated and deposed, in 1076 and 1080. On both occasions he made these declarations in a Council, at Rome, in speeches addressed to the patron saints of Rome – in 1076 to St Peter, in 1080 to St Peter and St Paul. Gregory was violent, but he was also heroic. The Popes claimed, and claim, to derive their authority direct from Christ, but it was his sense of being Peter's successor and representative, of being in direct touch with Peter himself, which was Gregory's special inspiration.

ALCHEMY

ETERNAL life; a cure for all diseases; the ability to turn common metals into purest gold: in the Middle Ages it was thought that these wonderful things could be brought about by the use of one transforming substance, called the Philosopher's Stone. The search for this substance was carried out by men known as alchemists, and although they never found the Philosopher's Stone they did make many valuable chemical discoveries.

Today, claims like those of the alchemists seem so fantastic that we marvel that they were ever believed. But if we look a little way into the story of alchemy it becomes easier to see why so many people believed that the Philosopher's Stone might exist.

The story of alchemy

The beginnings of alchemy are so far back in time that it is impossible for us, now, to see them at all clearly. It is certain, however, that the ancient civilisations of both China and India counted chemical manipulations (the changing of substances by chemical processes) among their skills, and that this knowledge and ability spread westward to the empires of Persia and Ancient Egypt. The tanning of leather, the preparation from common metals of alloys that looked like gold, and the manufacture of dyes and cosmetics were all techniques used by the Egyptians. But it seems that they were little interested in the science which lay behind their successes.

On the northern shore of the Mediterranean the Greeks had an outlook which was quite the opposite to that of the Egyptians. The aim of their science was to explain the nature of the Universe. Their interest in chemical manipulation lay not in its practical uses, but in the extent to which chemical theory might solve the mystery of life.

The Egyptian and Greek views of chemistry were so different that it seems incredible that they should ever have been united into a single science. However, Alexander the Great's conquest of Egypt in 332 B C attracted many Greeks to his new city of Alexandria, and in the university and library of that city the skills of the Egyptians were united with the theories of the Greeks, giving rise to the alchemists as we know them. Alchemy flourished greatly in Alexandria, surviving even the Arab conquest of A D 642. Indeed, these very invaders made important contributions to the development of alchemy. This fusion of the different approaches to alchemy is preserved in the word itself, which comes from the Arabic definitive article *al*, and *Khemia*, the Greek form of the native name of Egypt.

The Arabs produced one of the greatest alchemists of all time, Jabir ibn Haijan (721–813). He introduced many new ideas into alchemical thinking. Among them was the idea that alchemists should search among the entrails of rare and exotic animals, for he thought that the elusive Philosopher's Stone might be found there, rather than in metal ores.

During the years 711 to 714 the tide of Arab conquest reached Spain, carrying with it all Arab learning. In the Moorish universities of Barcelona and Toledo, scholars from all over Europe learnt the alchemists' art, and when they returned to their native countries they introduced the ideas to their fellow countrymen. Alchemy found a fertile soil in Europe. On one hand, genuine scholars tried to fulfil the expectations of the art, while on the other, charlatans (quacks) robbed the gullible with worthless promises of gold, health, and everlasting life.

In the end the failure of the alchemists to fulfil their promises brought about the downfall of their art. The fresh minds of Renaissance thinkers began to doubt the existence of the Philosopher's Stone. Without it there could be no transformation of base metals into gold, nor a cure for all diseases. Though

A mediaeval alchemist in his laboratory

the alchemists had discovered many chemical substances and methods, the theory behind their work was seen to be false. Under the influence of the Swiss physician Paracelsus (about 1490–1541) many alchemists abandoned the search for the Stone, and turned their attention to the preparation of drugs.

The ideas of alchemy

Underlying the alchemy of Alexandria was the Greek idea that all matter was composed of four elements, fire, air, earth, and water, united with a fundamental 'substance'. The different appearances of everyday things were attributed to the different proportions in which the elements were mixed.

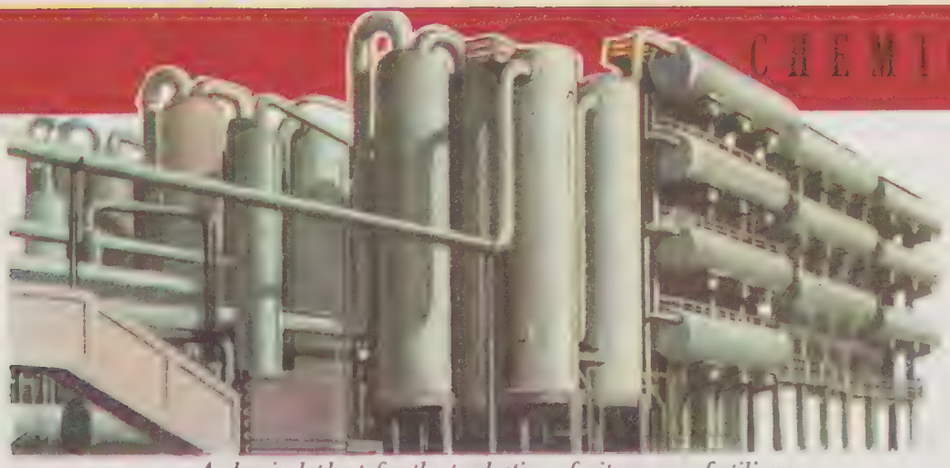
Jabir introduced the idea that particular combinations of the elements gave rise to mercury and sulphur, and that all the metals were formed from these two substances. For the production of gold, however, the mercury and sulphur had to be of especial purity – rather, in fact, miraculous 'essences' of these substances. Only then could the Stone change them to gold.

The central position which the Stone occupied in alchemy endowed it with many properties besides that of changing metals into gold. Indeed, half practical and half mystical, it lay at the centre of alchemical philosophy, a force to control all around it, and with power over even life itself.

THE ALCHEMIST'S LABORATORY

In the alchemical laboratory, the furnace was probably the most important single piece of equipment. On it the alchemist placed the crucible in which he roasted, or *calcined*, the ores with which his experiments so often began. In this way he drove off impurities in his attempts to prepare the pure 'essences' of mercury and sulphur needed for transformation into gold. The furnace was used also for *distillation*. Liquids boiled in strange-shaped vessels called *alembics*, and their vapours rose to condense in *still-heads* of even stranger form, the precious distilled substance falling, drop by drop, into a nearby receptacle. The alchemist used mortars and pestles for grinding his metal ores into fine powders. Odd-shaped pots and vessels stored his reagents (substances that are used in alchemical experiments). And on the table stood the books, which, in a strange and almost incomprehensible language, recorded the formulae and the recipes through which the alchemist hoped to achieve success.

CHEMICAL FERTILISERS



A chemical plant for the production of nitrogenous fertilisers

ONE of the most important of present-day problems is the production of enough food to feed the ever-increasing population of the world. It is estimated that there are almost 3,000 million people at present on the earth, and by the end of the century it is expected that there will be double this number. The area of the earth's surface which is suitable for the growing of crops is limited, and the only way to produce enough food is to make full use of modern scientific farming methods.

Weedkillers, insecticides, and improved varieties of plants, all help to increase the amount of food that can be produced, but the greatest increase in the yield of crops, particularly on poor soils, is brought about by the use of fertilisers.

Every plant needs certain mineral substances in order to grow. The chief of these are nitrogen, potassium, and phosphorus. Calcium phosphate is the basic fertilising salt of phosphorus. A good crop of wheat, which may yield two tons of grain from an acre of land, takes about 100 pounds of nitrogen, 45 pounds of potassium, and 30 pounds of phosphorus from this acre of ground. Even a good soil cannot continue to provide these substances, in these quantities, year after year. A poor soil may not even contain enough of them in the first place to give a good crop.

The advantages of chemical fertilisers

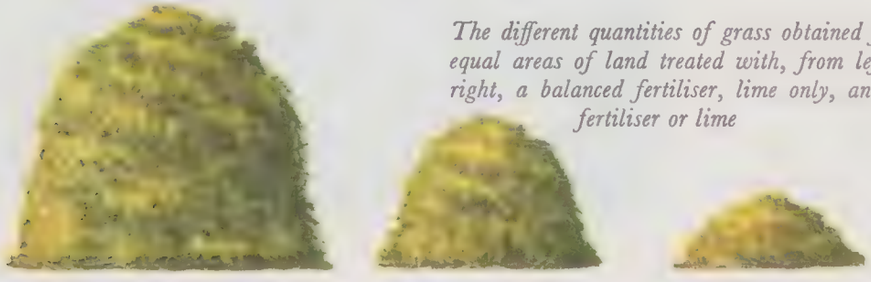
It has been known for centuries that organic matter, such as manure and compost, will provide nourishment for the soil, but these natural fertilisers are limited sources of the essential minerals required for plant growth. Stable manure supplies only about 10 pounds of nitrogen, 4 pounds of phosphorus, and 8 pounds of potassium in every ton. This means that 10 tons of manure are needed to replace the minerals removed from an acre of ground by a single year's wheat crop. Natural fertilisers are bulky, inconvenient to apply, and difficult to transport. Chemical fertilisers provide the essential plant food, and are concentrated, and convenient to store, handle, and spread.

Chemical fertilisers have another advantage: they can be used to supply just one or two of the minerals if these are all that the soil is short of. Manure can only supply all three at once, and two may be quite unnecessary.

Fertilisers containing nitrogen

Modern chemical fertilisers designed to supply nitrogen are made from the nitrogen of the air. This is first converted to ammonia by reduction with hydrogen (see page 1878). The ammonia is then converted to a salt or other compound which can be spread on the soil to provide nitrogen in a form which can be used by the plants.

Ammonium salts used as fertilisers include ammonium sulphate and ammonium nitrate. The latter compound is a particularly rich source of nitrogen, since ammonia itself contains nitrogen, besides that which is added to it in the nitrate. Another compound used to supply nitrogen is urea.



The different quantities of grass obtained from equal areas of land treated with, from left to right, a balanced fertiliser, lime only, and no fertiliser or lime

Fertilisers containing potassium

Potassium salts are found in natural deposits in many parts of the world, particularly in Germany. These are often converted to potassium chloride for use as fertilisers, but sometimes they are used in their natural state. An example of this is Kainit, which is used as a fertiliser in Great Britain.

Fertilisers containing phosphorus

Phosphorus is found as calcium phosphate in bones and in certain rocks. It is also present in *basic slag*, a waste product formed during the smelting of iron ores.

Although phosphate rock can be used directly to supply phosphorus to plants, it is not very satisfactory, since the phosphorus in it is not in a form which plants can use directly. But if the rock is treated with sulphuric acid the phosphate is converted to *superphosphate*, which contains phosphorus in a readily available form. Millions of tons of superphosphate are used every year.

Calcium

Calcium is not a major plant nutrient in the same way as nitrogen, phosphorus, and potassium, but small amounts are essential for plant growth. Calcium is a constituent of lime, millions of tons of which are used every year to adjust the degree of acidity or alkalinity in the soil. Lime also improves soil texture and makes it more suitable for cultivation.

Use of fertilisers

The modern farmer who wants to cultivate new land, or grow crops which he has not grown before, has a soil analysis carried out. This tells him how much nitrogen, phosphorus, and potassium there is in his soil already, and also its degree of acidity or alkalinity. Since he knows the quantities of each nutrient which give the best yield for any particular crop, the farmer can add just the right amount of each for the crop he wishes to grow, in the form of chemical fertiliser.

He can also calculate how much lime he should add to adjust the soil to the degree of acidity or alkalinity best suited to the crop. If the same crop is grown year after year he can buy ready-mixed fertiliser which will automatically provide a correctly balanced mixture to replace the nutrients removed by the crop.

PLAY-IT-COOL EARLS ARE HOT UNDER THEIR COLLARS

TWO of England's most powerful men are today hot under the collar. Edwin, Earl of Mercia, and Morcar, Earl of Northumbria, took no part in the battle of Stamford Bridge. They said that their armies had been severely mauled five days earlier at Fulford where they attempted to beat off Hardrada before Harold's arrival from the south. But this play-it-cool policy has angered Harold, who claims that the defeated earls promised to aid the invaders on their planned march on London – a march that was only prevented by Harold's success at Stamford Bridge.

Earls Edwin and Morcar – they will have to answer some very awkward questions about their behaviour during the last few days

GEBUR DEFIES ABBOT
Row over boon work

EGBERT, a gebur, was accused last week of refusing to obey his lord the Abbot of Abingdon, one of the most powerful English Abbots.

The Abbot claimed that as Egbert belonged to the gebur class of workers he was therefore bound to work for him on three days a week in August. In reply Egbert admitted this, but said that the Abbot had demanded more than his due last July. Egbert claimed that the Abbot had made him plough ten acres as boon work, instead of the customary three.

The Abbot replied that this had been necessary on account of bad weather, and a hold-up in work. The other classes of his workers, he went on, like the kotsetlan and the wealthier geneats, had accepted the work without complaining.

The case will be continued at the next session of the hundred court.

KOTSETLA HANGED FOR STEALING

CYNWOLD, a 30-year-old kotsetla, was hanged yesterday at Bury St Edmunds for stealing a pair of shoes. He was tried by the private court of the monastery in accordance with the right of Infangenetheof. This gives landowners the right to inflict punishment on any thieves they catch red-handed on their property – they do not have to send them for trial in the courts of the shire or hundred.

False prophet says God angry with king

WITNOTH, aged 28, a geneat of Bere, in Devon, was accused in the hundred court at Bere of prophesying the downfall of Harold in his recent battle against the invaders from the north. Witnoth had alarmed many with the prophecies in which he claimed the wrath of God would fall on Harold after his excommunication by the Pope. In his defence Witnoth claimed the huge long-tailed star, which had 'shone as brightly as the moon' throughout March this year, was a sure sign of God's anger that Harold had become king.

Judicial ducking ends in tragedy

YESTERDAY, tragedy struck following proceedings in the shire court of Hampton. Ethel, a Winchester widow, had been accused in the shire court of witchcraft. In accordance with the law she was thrown into a well of water to see if she was innocent or guilty. The water had been blessed. If she had floated and the water had refused to receive her she would have been declared guilty. But she sank and so was declared innocent. Unfortunately, by the time she was hauled out she had been drowned, and those responsible for the careless handling of the trial have been ordered to bear the cost of her funeral.

HAROLD WINS GOLD AS WELL AS GOLDEN OPINIONS

AMONG the treasures captured from Harold Hardrada was his famous block of gold. Twelve men can lift this block only with a great deal of difficulty. Hardrada brought the block to England, expecting to be able to add to it with the gold he would obtain by plunder. He should have left it, like he did his wife and the ladies of his court, under the protection of Malcolm, King of Scotland, England's northern enemy.

Announcement for readers of Blue Knowledge

The Standard Binder for Volume 3

The Easibinder for Volumes 3 & 4

AVAILABLE NOW!

The standard binder for Volume 3 and the Easibinder for Volumes 3 and 4 are available *now*. See your newsagent right away. The standard binder costs 3s. 6d. and the Easibinder 13s. 6d.

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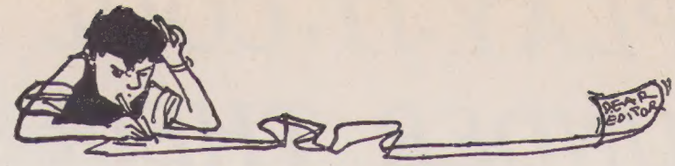
If you have any difficulty in obtaining your binder write to Department B, Knowledge, 37 Hertford Street, London W.1. There is a 1s. 3d. charge on each order from Department B, but more than one binder can be ordered for the same charge.

This issue contains the Index for Volume 2. This goes on the last string of your Volume 2 standard binder, or the last rod of your Volumes 1 and 2 Easibinder.



Used Stamps

DEAR EDITOR—The Muscular Dystrophy Society can use old stamps. They sell them overseas and the money received goes towards their fund. I was hoping that other readers might like to help, for I have already collected over 5,000 stamps for the society. Any postage stamps will do, from any country, including Britain.

A. W. Johnson,
14 Wirral Way, Noctorum,
Birkenhead, Cheshire.

Please send the stamps to either Master Johnson or The Muscular Dystrophy Society, 26 Borough High Street, London S.E.1.—Editor.

Snake Fancier

DEAR EDITOR—I collect snakes and reptiles as a hobby. As you can imagine, there are many different types here in South Africa. If anyone else shares my interest, would they please write to me?

Roy Astrup (age 15),
3071 Marine Drive, Bluff,
Durban, Natal,
South Africa.

Two Tongues

DEAR EDITOR—In your article on Celtic Lands (*Knowledge* No. 13) you give an account of the Celtic tongues that are still spoken, but only mention very briefly the Gaidel Celtic language, Manx, and the Brythonic Celtic language, Cornish.

In 1901, the number of people speaking Manx was 4,657, but by 1951 the number was only 358, all of them bi-lingual. Manx is still used in the Isle of Man Parliament, the House of Keys, but there are now probably no more than 200 people who know how to speak Manx.

As for Cornish, it died out as a spoken language with the death of Dolly Pentreath in 1777. However, a grammar and dictionary were published in 1882 and 1887 respectively.

More information on Celtic languages can be found in *A Concise Comparative Celtic Grammar* by H. Lewis and H. Pedersen, published by Gottingen, 1934.

J. A. Holyhead,
58 Hastings Road,
Castle Lane,
Bournemouth.

Rain on the Rock

DEAR EDITOR—I have lived in Gibraltar for two years, and so found your article (*Knowledge* No. 117) very interesting. I must tell you about a very peculiar thing that happens nearly every year here. Towards the end of summer, water becomes very scarce and no rain is expected for several weeks. An urgent request is sent to either Morocco or England for a tanker to bring us some water. About three or four days later the tanker arrives, greeted by a heavy rainstorm, the first of the season. The Government are very harassed because they need not have sent for the tanker after all. But perhaps the rain would not have fallen if the tanker had not been ordered.

Another peculiar thing is the 'Levante', a heavy, grey cloud which seems to hang motionless over the Rock. On any day of the year you might wake up with the Levante clinging to the Rock. It often affects people by giving them stomach-ache or a sore throat. It weighs down on everybody, dampening spirits and causing a deep depression. It is even more aggravating if Algeciras (just across the bay) is bathed in hot sunshine.

Linda Hammon (age 14),
Sunset Residence,
St Bernard's Road,
Gibraltar.

Thank you for this interesting account of the peculiarities of 'the Rock'.—Editor

Vanishing Shilling

DEAR EDITOR—Can anyone solve this? Three men go into a restaurant with 10*s*. each. Their meal costs 25*s*., but the waiter decides to say it is 27*s*. and pocket the odd 2*s*. Each man gives him their 10*s*. note. He gives them each 1*s*. change on their false 27*s*. bill.

They have each therefore paid 9*s*., making 27*s*. in all, and the waiter has 2*s*. That makes 29*s*. Where is the other shilling?

Claire Morley,
10 St Stephen's Crescent,
London W.2.

How well did you read the historical newspaper?

1. Which two leaders did Harold beat at the battle of Stamford Bridge?
2. Who was Harold's father?
3. What was the famous banner of Harold of Norway called?
4. Near which city was the battle of Stamford Bridge fought?
5. What was England's 'home guard' called?
6. Which English earls were defeated at the battle of Fulford?
7. Which Pope gave his blessing to William the Conqueror's claim to the English throne?
8. Who was the Bishop of Bayeux at this time?
9. Who was Archbishop of Canterbury?
10. Who was King of France?
11. What was the lord's right of summary justice on thieves?
12. Name three classes of Anglo-Saxon peasants mentioned in the newspaper.

ANSWERS

1. *Harold Hardrada, King of Norway, and Tostig, Harold of England's brother, formerly Earl of Northumbria.*
2. *Earl Godwine of Wessex.*
3. *The Land Waster.*
4. *York.*
5. *The Fyrd.*
6. *Edwin, Earl of Mercia, and Morcar, Earl of Northumbria.*
7. *Pope Alexander II.*
8. *Odo, half-brother of William, Duke of Normandy.*
9. *Stigand.*
10. *Philip I.*
11. *Infangenetheof.*
12. *Kotsetla, gebur, geneat.*

BRAIN ? BOX

1. Bill, Ethel, and Mary are all at school. Bill is now as old as Mary was when Bill was Ethel's present age. Ethel was then half what Bill is now, and one-third of what Mary will be in three years' time. How old are these three children?
2. ONTO GUN; FEW KILLED. This imaginary dispatch contains the name of a great commander of which it is an anagram. Who was he?
3. 'The nightingale, if she should
   sing by day,
   When every goose is cackling,
   would be thought
   No better a musician than the wren.'
   So said Portia in Shakespeare's *The Merchant of Venice*. Can you criticise this extract on two points?

ANSWERS

1. Ethel 9; Bill 12; Mary 15.
2. DUKE OF WELLINGTON.
3. It is the male nightingale that is the beautiful singer and it does sing by day.

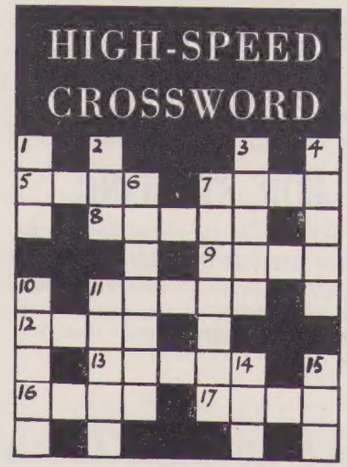
HIGH-SPEED CROSSWORD

Clues Across

5. Necessity (4).
7. Entry in a ledger (4).
8. Table birds for Christmas (5).
9. It has to be a long one to have no turning (4).
11. The F.A. Cup one is always held at Wembley (5).
12. —— of campaign (4).
13. Veers towards (5).
16. Old-fashioned drink with honey in it (4).
17. Herb for a wise man (4).

Clues Down

1. Finish (3).
2. Used to keep clothes on the line (3).
3. Pilfer (5).
4. Colour between red and green (5).
6. Described in words (7).
7. Jersey and Guernsey are Channel ones (7).
10. Sea-spray (5).
11. Killing (5).
14. Unhappy (3).
15. Daniel was thrown into one (3).



Solution next week

SOLUTION TO LAST WEEK'S CROSSWORD

ACROSS: 1 Thatched; 6 Nib; 7 Irish; 8, Checkmate; 10, Toast; 12, Act; 13, Thirteen. DOWN: 1, Tenacity; 2, Amble; 3, Cricketer; 4, Eli; 5, Threaten; 9, Awake; 11, Ash.

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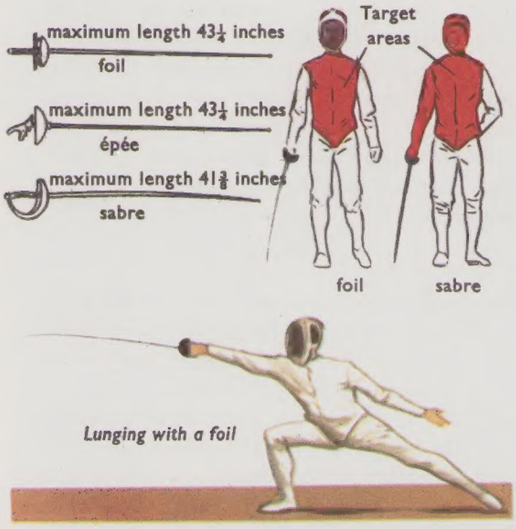


Three different weapons are used in fencing – the foil, the sabre, and the épée

after its invention, the game was taken to India, where it was played by British army officers. In the 1880's badminton developed in England. In its early years it suffered from having no standard set of rules. It took 20 years before laws were drawn up privately for the game, but even these were not universally followed. In 1893, however, the Badminton Association was founded in England. Today badminton is a highly popular indoor sport, and is considered to be one of the two or three fastest games ever invented.

Badminton is an indoor game played with a very light racket, and a shuttlecock instead of a ball. The feathers on the shuttlecock are intended to slow up the pace of the cork base, but its speed when hit hard is in fact little less than that of a lawn tennis ball. The player strikes the cork base, and as the shuttlecock does not bounce he has to strike on the volley (that is, while it is in the air and before it can bounce). Continually hitting on the volley makes this a very fast game indeed. Only the server can score points, and the non-server has to win a point in order to gain the service. The winning score is 15 points.

Archery – an increasingly popular competitive sport in Britain

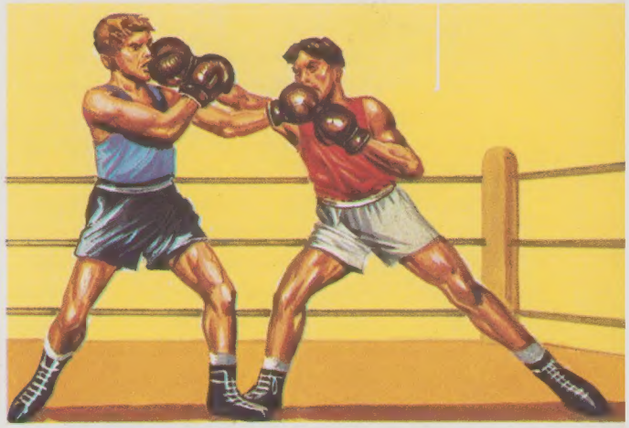
Archery

The bow and arrow has been used for animal hunting from the earliest times. It also has a long history as a weapon in warfare, and was much used at such famous mediaeval battles as Crécy, Poitiers, and Agincourt. Certain men came to be famed for their skill in handling the bow, both in battle and in friendly competition on the village green. An old ballad tells how Robin Hood split a stick from 400 yards, and we have all heard the story of how William Tell shot an arrow to pierce an apple which he had placed on his son's head. Many different feats of skill with the bow inspired wide admiration, and as it gradually came to be replaced by the use of fire-arms as a weapon, the pleasure it provided in skilful competition survived. Today archery is a widespread sport with a great many enthusiasts.

There are several different forms of modern archery, and target shooting is particularly popular. A certain number of arrows, called a round, are shot at a target over given distances. In England men compete in the York round, shooting six dozen arrows at 100 yards, four dozen at 80 yards, and two dozen at 60 yards. Ladies shoot the Hereford round of six dozen arrows at 80 yards, four dozen at 60 yards, and four dozen at 50 yards. Normally, three arrows are shot at the target; these are then scored, pulled from the target, and shot at another target in the opposite direction, four such ends making a dozen.

The standard target is 48 inches in diameter, with a gold-coloured centre 9 inches in diameter, and with four rings 4 inches wide, coloured red, blue, black, and white. Hits on gold score nine, on red seven, on blue five, on black three, and on white one.

Bows are usually made of yew or degame (lemonwood).



The boxer on the right lands a solid right to the jaw

The arrows are made of well-seasoned deal (or Norway pine), Port Orford cedar, or special aluminium alloy and steel tubing.

Rifle-shooting

Another sport which has developed out of a weapon used in warfare is that of rifle-shooting. In 1860, when the rifle had been generally adopted for use in the army, interest in it became widespread in Great Britain, and the National Rifle Association was founded. Since that time the accuracy of the rifle has continually increased, and now an expert marksman using a service rifle of ·303 inches bore can shoot bullets into a circle 2½ feet in diameter from a distance of 1,000 yards. The bore of a rifle is the measurement of the diameter inside the barrel.

Each year a meeting is organised by the National Rifle Association at Bisley, and this attracts marksmen from all parts of Great Britain as well as from overseas, who eagerly compete for many challenge trophies and other prizes.

An extremely popular form of rifle-shooting in Great Britain is small-bore, where rifles with a bore of ·22 inches are used. Small-bore rifle-shooting generally

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takes place over a distance of 25 yards, but the rifle can also shoot accurately at 50 to 100 yards. One advantage of using the ·22 rifle on a small range is that the range can be easily enclosed, and many clubs have indoor ranges where the sport can be continued comfortably throughout the winter and bad weather. Small-bore rifles are used in schools and by cadet organisations.

Fencing

Fencing is a sport with a long and fascinating history, which has its roots in the traditions of chivalry which arose in Europe during the early Middle Ages. In spite of its romantic and historical associations, however, fencing is today an active and highly developed modern sport, which is becoming more and more popular throughout the world.

In Britain, a revival of interest in fencing began in the mid-19th century, and this led to the foundation in 1902 of the Amateur Fencing Association, which is the governing body of the sport in Great Britain and Northern Ireland.

Three different weapons are used in fencing – the foil, a light and flexible weapon with a tip; the sabre, which has a point and a blade; and the épée, which has a point and a stiff triangular blade.

People fencing with foils should only hit their opponent's trunk (not including his arms); with the sabre blows on the trunk, mask, and covered arm are valid; the épée can strike any part of the body.

Boxing

Boxing has its roots in England. The first recorded fights which were fought in a boxing ring took place over 250 years ago, and the first set of rules for boxing, Broughton's Rules, came into force a few years later. John Broughton, born in 1704, is known as the 'Father of the English School of Boxing', and the rules he made are said to have formed the basis of the Queensberry Rules.

However, boxing as we know it today is less than 80 years old, for the first heavyweight title contest fought with gloves took place in 1892, and the fashion of using a covering for the fists has remained ever since. The Queensberry Rules, which govern boxing, take their name from the Marquess of Queensberry, who drew them up, and came into force around 1867. The present rules of boxing are a modified form of these.

With the arrival of boxing gloves, matches were arranged between men of equal weight, and eventually eight classes were decided upon as follows:

Flyweight	8 stone and under
Bantamweight	8 stone 6 pounds and under
Featherweight	9 stone and under
Lightweight	9 stone 9 pounds and under
Welterweight	10 stone 7 pounds and under
Middleweight	11 stone 6 pounds and under
Light Heavyweight	12 stone 7 pounds and under
Heavyweight	any weight

A boxing ring is roped, and not less than 14 feet or more than 20 feet square. No contest today can last for more than 15 rounds, and no round must last for more than three minutes, with one-minute intervals. When a boxer is knocked down, he must rise within ten seconds, and his opponent retires out of striking distance. If he cannot rise, and the ten seconds are counted out by the referee, then his opponent is said to have won the match by a 'knock-out'. Otherwise the result depends on points awarded each round for hits with the knuckle part of the glove on the 'target' area, which includes the face, jaw, and front part of the body above the belt. Blows off the target area do not count as points, and blows below the belt or behind the neck can mean disqualification for the offender.

Golf

Golf was first played in Britain on the golf links of Musselburgh in Scotland, and it was in Scotland also, at the Royal and Ancient Club of St Andrews, that the first rules of the game of golf were laid down.

There are two principal sets of rules for golf, those of match play and those of stroke play. In match play it is the player (or side) who wins the greater number of the 18 holes which form a golf course who wins the match. Individual holes are won by the player who succeeds in hitting his ball into the hole in the least number of strokes.

In stroke play, on the other hand, the player wins who completes the round of 18 holes in the smallest total number of strokes.

There are a great variety of golf clubs, because different types have to be used for striking different distances. In championship and competitive golf each player is allowed to take a maximum of 14 clubs on to the course. The golf ball has a diameter of not less than 1·62 inches, and a weight of not more than 1·62 ounces.

Angling

Possibly the most international of all sports is angling, for it is true to say that there is no country in the world where this sport is not enjoyed in some form or another. We also know that it was enjoyed by the Ancient Egyptians, Greeks, and Romans. But according to the most famous of all anglers, Izaak Walton, angling is a contemplative man's recreation, and it is therefore not internationally competitive to any great extent. The spirit of competition is keen, however, among association and club anglers, and many countries, including Great Britain, hold their own freshwater and sea fishing championships. International events mostly concern sea angling.

Angling is the art of catching fish by rod, line, and hook, or by line and hook, and the special skill in the pursuit consists of alluring the prey by the use of an attractive bait. Various techniques are used, including dry and wet fly fishing, and spinning, and the angler has to acquire a good deal of knowledge mainly through practical experience. In addition to his understanding of the different types of fishing tackle, and his dexterity in using them, he must learn the haunts and habits of the fish in which he is interested. He also needs rather more patience than is necessary for most out-of-door sports.

Fish caught by angling in Britain are the salmonidae – such as salmon, trout, char, and grayling; and the coarse fish which spawn in summer – such as pike, perch, dace, roach, chub, bream, carp, barbel, tench, and gudgeon.